3.3.3 Assessing Vulnerability: Identifying Assets

The Louisville Metro hazard vulnerability section incorporates best available data from national, state, and local data sets. The vulnerability assessment methodology was influenced by Kentucky, North Carolina, and Rhode Island's hazard plan methods. The vulnerability estimates are being developed to understand relative risk and potential losses from the identified hazards. Please note: uncertainties are inherent in any loss estimation methodology, arising in part from incomplete scientific knowledge concerning natural hazards and their effects on the built environment. Uncertainties also result from approximations and simplifications that are necessary for a comprehensive analysis (such as incomplete inventories, demographics, or economic parameters).

LOJIC staff used best available data and methods, to determine Louisville Metro's vulnerability to twelve natural hazards. Following is the method used.

Vulnerability Assessment Methodology

Research shows there is no single way to determine Hazard Vulnerability. Staff spent numerous hours researching and conducting test runs to determine the best methodology for Louisville Metro. The final model was selected because it relies heavily on GIS software and provides the reader several layers of information that can be used individually for their own information needs.

To facilitate data collection and analysis, census tract boundaries were used to organize the data inputs (See Appendix 1 For Census Tract Map). This approach enabled the creation of a "vulnerability score" for each census tract and for each hazard. As a result, the Planning Team, Advisory Committee, and decision makers can concentrate mitigation actions on specific areas of the metro area.

Model
Hazard Vulnerability Score = Exposure Score X Hazard Score

To determine a Hazard Vulnerability Score, staff measured what census tracts would be exposed to each natural hazard. For our model, the Exposure Score is comprised of seven different variables called "ranks" and, as a result, the exposure score places human variables into the hazard vulnerability score.

Exposure Score

Exposure Score = total of seven variables (Population Rank + Building Rank + Essential Facilities Rank + Utility Facilities Rank + Social Vulnerability Rank + Potential High Loss Rank + Transportation Rank). See the Exposure Score map, in this section, and Appendix 13 for exposure scores by census tract.

See Appendix 13 for all of the tables referenced below.

Definition of Seven Variables

1. *Population Rank* – Census tract population is taken from Census 2000. See the Population Rank map in this section and Appendix 13 for the population and rank by census tract.

2. *Building Rank* – Real Property Assessments and building content, by parcel, from the Jefferson County PVA data. Plus, a count of buildings built before 1980, because building code upgrades and implementation of floodplain ordinances occurred after 1980.

   See the Building Rank Map in this section and Appendix 13 for the property value, total buildings built before 1980, and ranks by census tract.

3. *Essential Facilities Rank* – Census tract count of several different essential facilities. This data was derived from HAZUS-MH, Louisville Metro databases, EOP, Jefferson County Public Schools, LOJIC, Louisville Water Co., EMA, Jefferson County Fire Districts, Metropolitan Sewer District, and state databases. Essential facilities include:
   a. Hospitals, schools, emergency operation centers, fire stations, police stations, and nursing homes.

   See the Essential Facilities Rank map in this section and Appendix 13 for the number of essential facilities and rank by census tract.

4. *Utility Facilities Rank* – Census tract count of several different utility facilities. This data was derived from LOJIC, HAZUS-MH, Louisville Metro databases, Louisville Water Company, and state databases. Utility facilities include:
   a. Communication facilities, electric power facilities, potable water facilities, sewer lines, gas lines, water lines and waste water treatment facilities.

   See the Utility Facilities Rank map below and Appendix 13 for the number of utility facilities and rank by census tract.

5. *Social Vulnerability Rank* – Totals, by census tract, of the following data from the 2000 Census:
   a. Population living with poverty, total number of families with a female head of household, total number of population renting, population receiving disability assistance, population that is considered linguistically isolated, population that does not own a vehicle, population that is over the age of 65, total number of manufactured homes, and population receiving public assistance.

   See the Social Vulnerability Rank map in this section and Appendix 13 for the rankings by census tract, per issue.

6. *Transportation Rank* – Census tract information and total count is based on several different transportation facilities. This data was derived from LOJIC, HAZUS-MH, Louisville Metro databases, and the Kentucky Transportation Cabinet. Transportation includes:
    a. Airports, bus stations, highway bridges, railroad stations, railroad track footage, and highway footage.

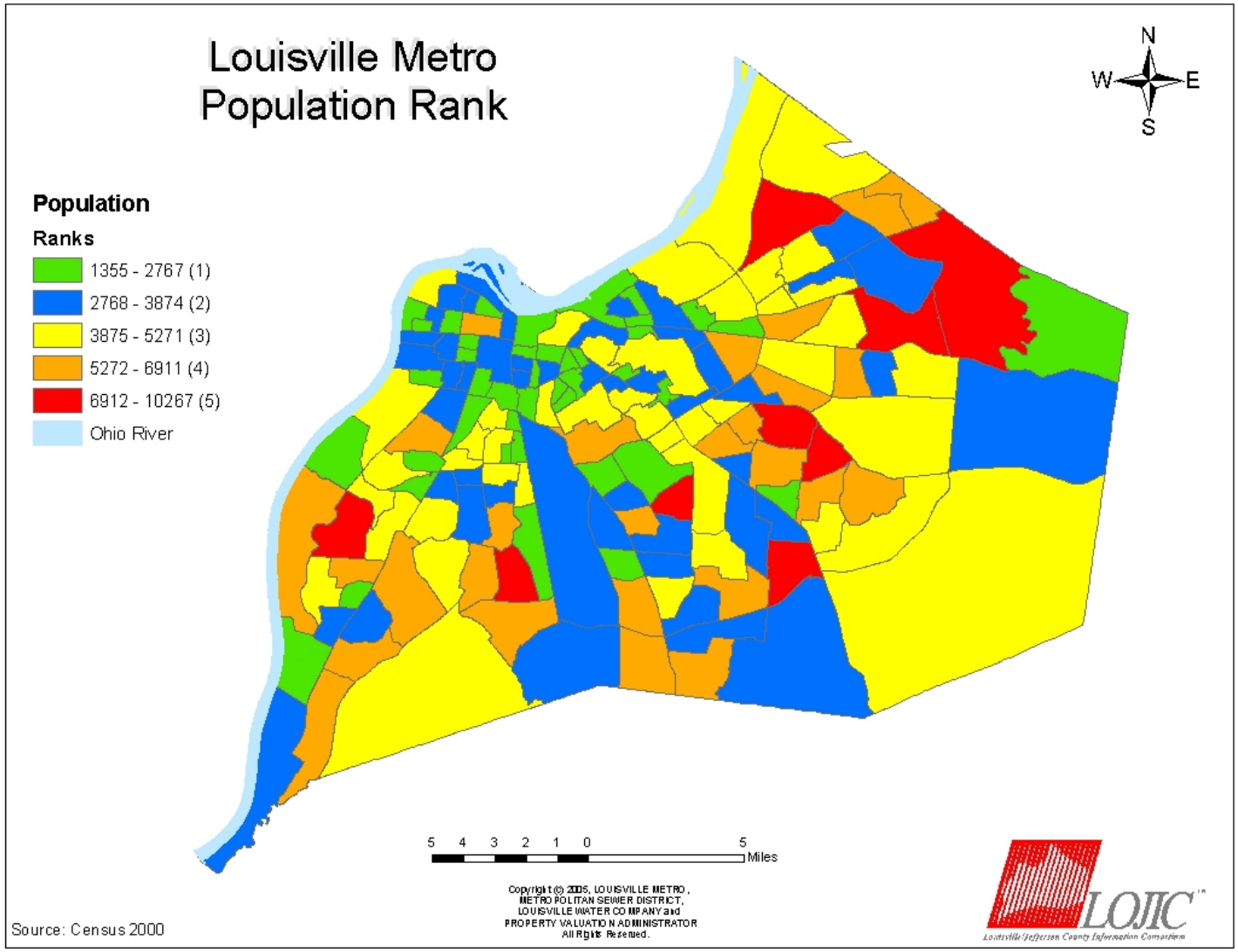
    See the Transportation Facilities map in this section and Appendix 13 for the number of transportation facilities and rank by census tract.

7. *Potential High Loss Rank* – Count of hazardous material storage sites and military instillations within each census tract. This data was derived from LOJIC, HAZUS-MH, and Louisville Metro databases.

    See the Potential High Loss Rank map in this section and Appendix 13 for the number of high loss locations and rank by census tract.

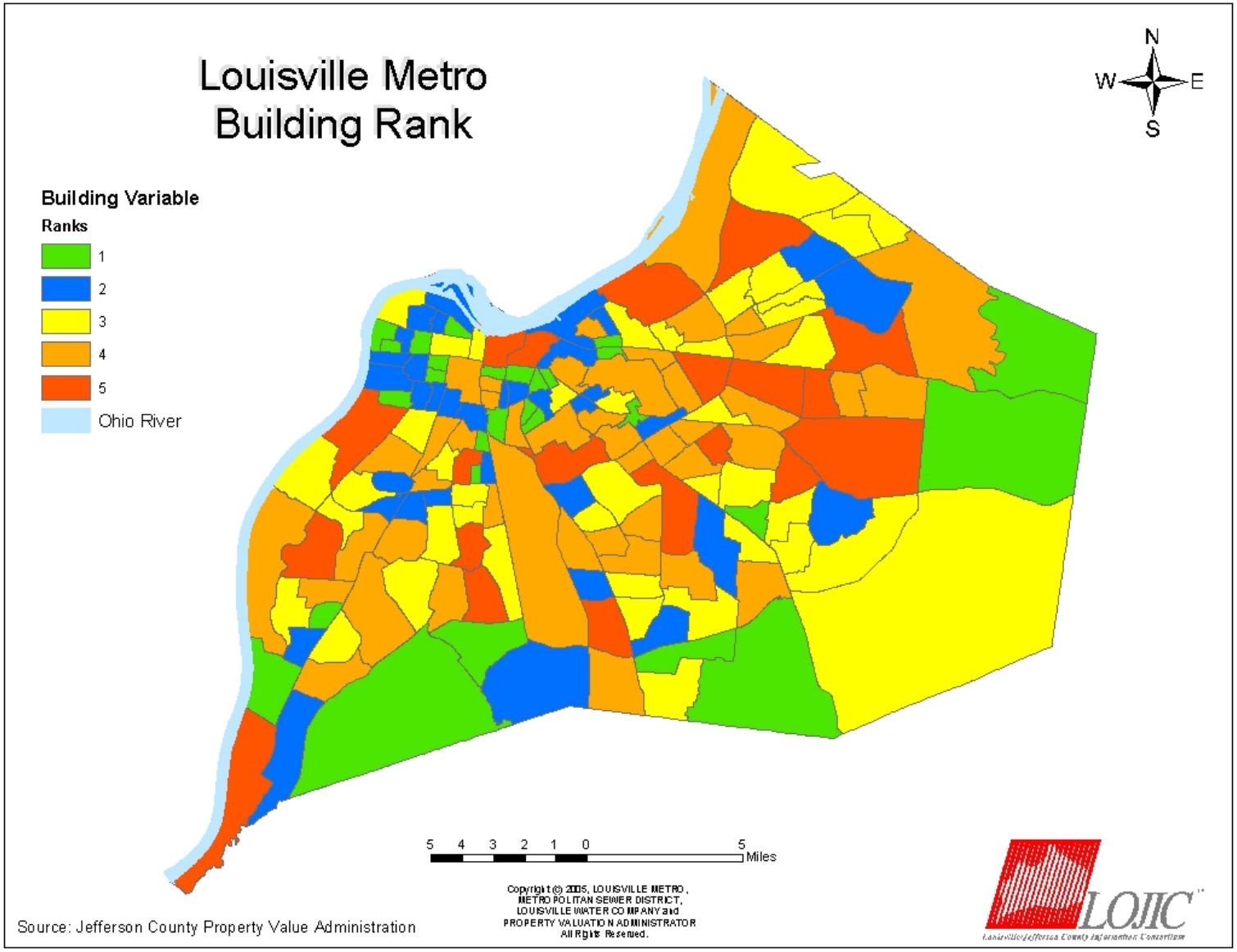
Each variable (see list above) was calculated and then ranked 1-5 (1=low, 5=high), using the Natural Breaks (Jenks) method provided in ArcGIS as a classification choice. Next, the ranks were added to produce an Exposure Score, one of the variables used to equate the Hazard Vulnerability Score. A more detailed explanation of each “Rank” can be found in the corresponding sections.

Population Rank Map



Population for each census tract was obtained from the 2000 Census and then ranked 1-5 (1=low, 5=high), using the Natural Breaks (Jenks) method provided in ArcGIS as a classification choice.

Building Rank Map



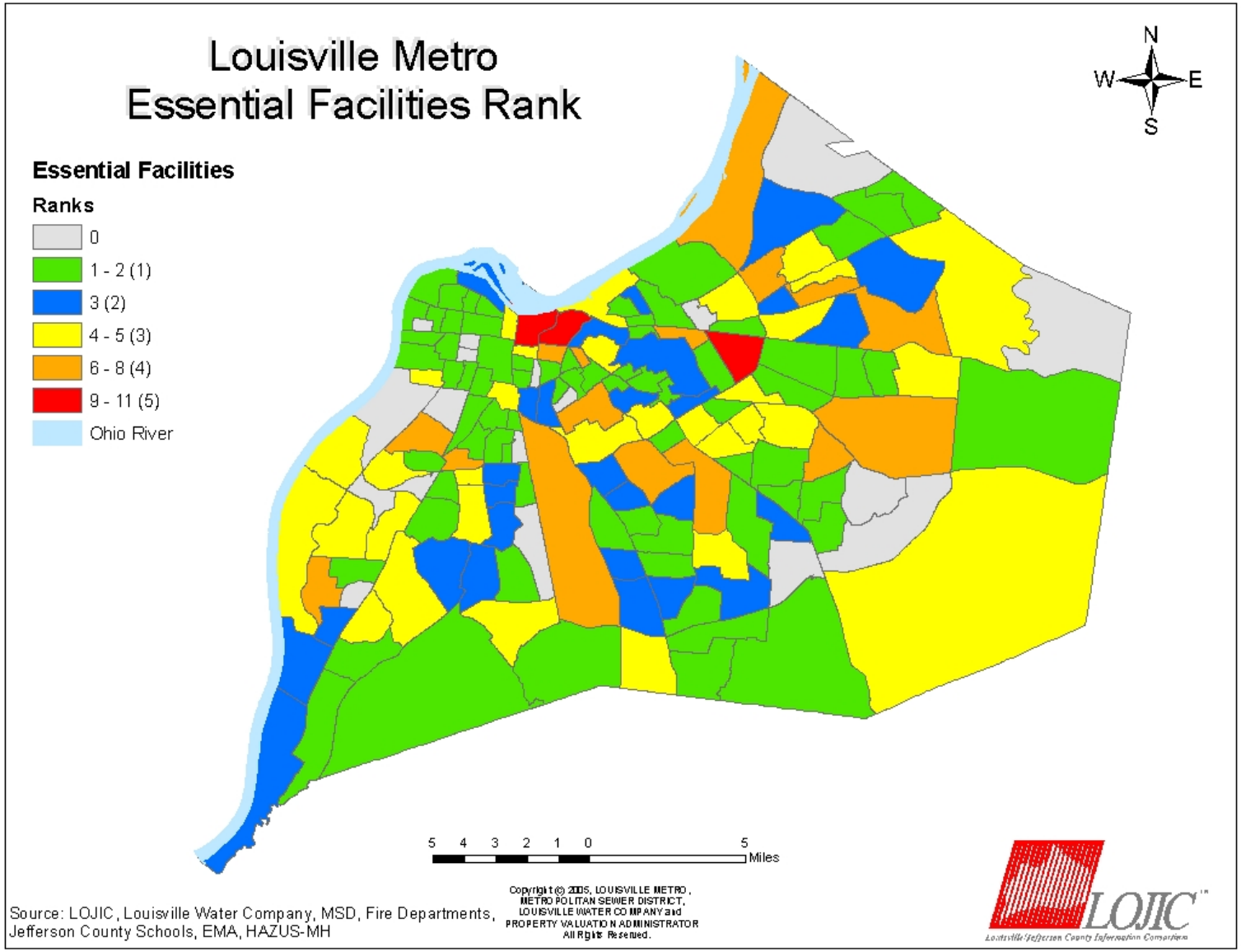
Property values include both the improved value by parcel from Jefferson County PVA and building content value derived by using the formula provided in the FEMA “How to Guide’s” (P. 3-11).

Values were ranked 1-5 (1=Low, 5=high), using the Natural Breaks (Jenks) method provided in ArcGIS; producing a property value rank per census tract.

Second, because building code upgrades occurred after 1980, a count of buildings built before 1980 was created for each census tract and those totals also ranked.

Next, the property value rank and building age rank were totaled to produce the Building Score (See Building Rank Table in Appendix 13). The Building Score was ranked, by census tract, using the method described above to produce the Building Rank. This variable represents property value and building age, for each census tract, in the Exposure Score.

Essential Facilities Rank Map

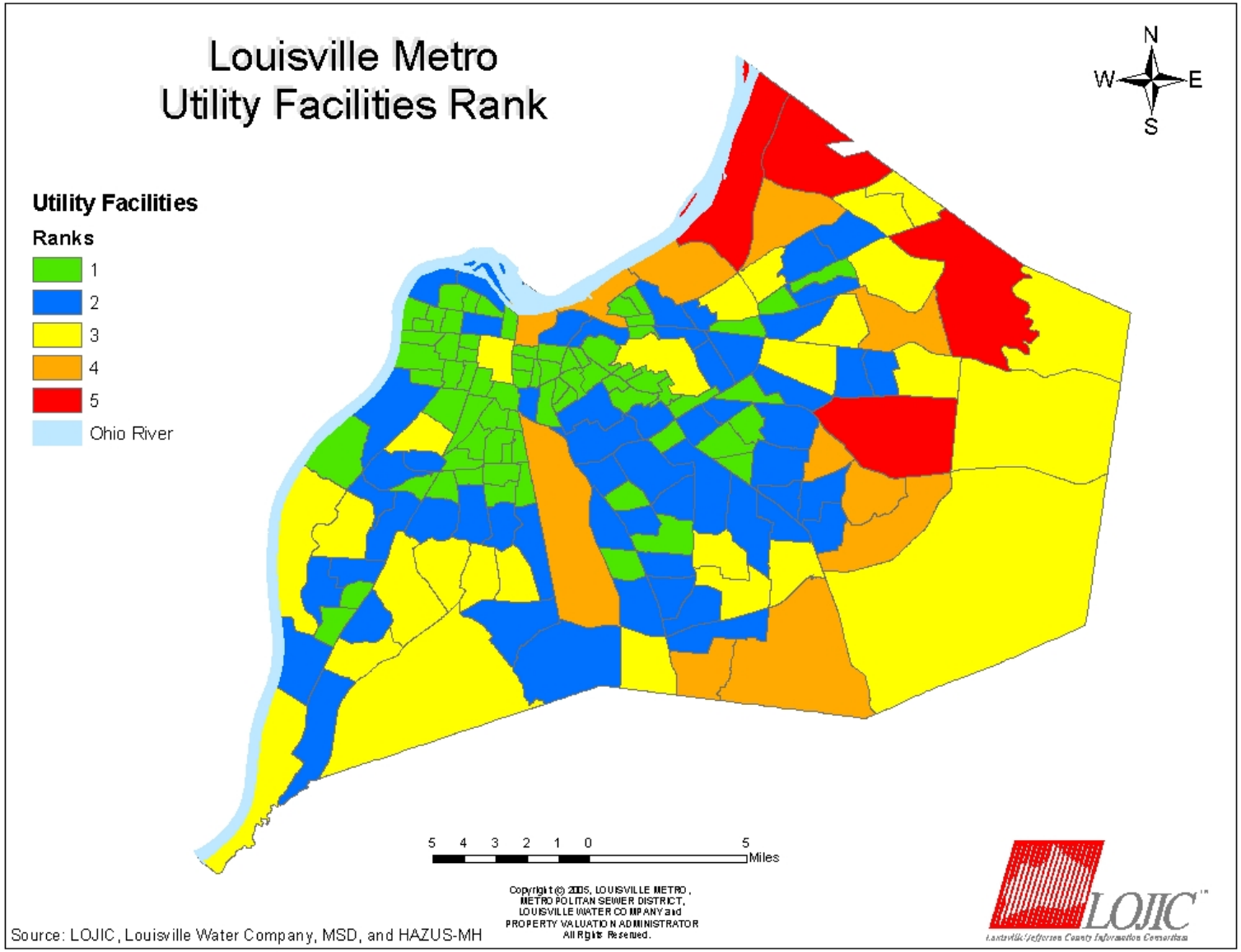


An Essential Facilities count by census tract was derived from HAZUS-MH, Louisville Water Company, LOJIC, Jefferson County Public Schools, Metro and Suburban Fire Districts, EMA, Metro Sewer District, state databases, and other Louisville Metro databases.

The total number of essential facilities is the sum of: hospitals, fire stations, schools, emergency operation centers, nursing homes, and police stations, by census tract.

The total number of essential facilities, by census tract, was ranked 1-5 (1=low, 5=high), using the Natural Breaks (Jenks) method producing an essential facility rank, used later in the Exposure Score (See Essential Facility Table in Appendix 13).

Utility Facility Rank Map



A Utility Facility count by census tract was derived from HAZUS-MH, Louisville Water Company, LOJIC, state databases, and Louisville Metro databases.

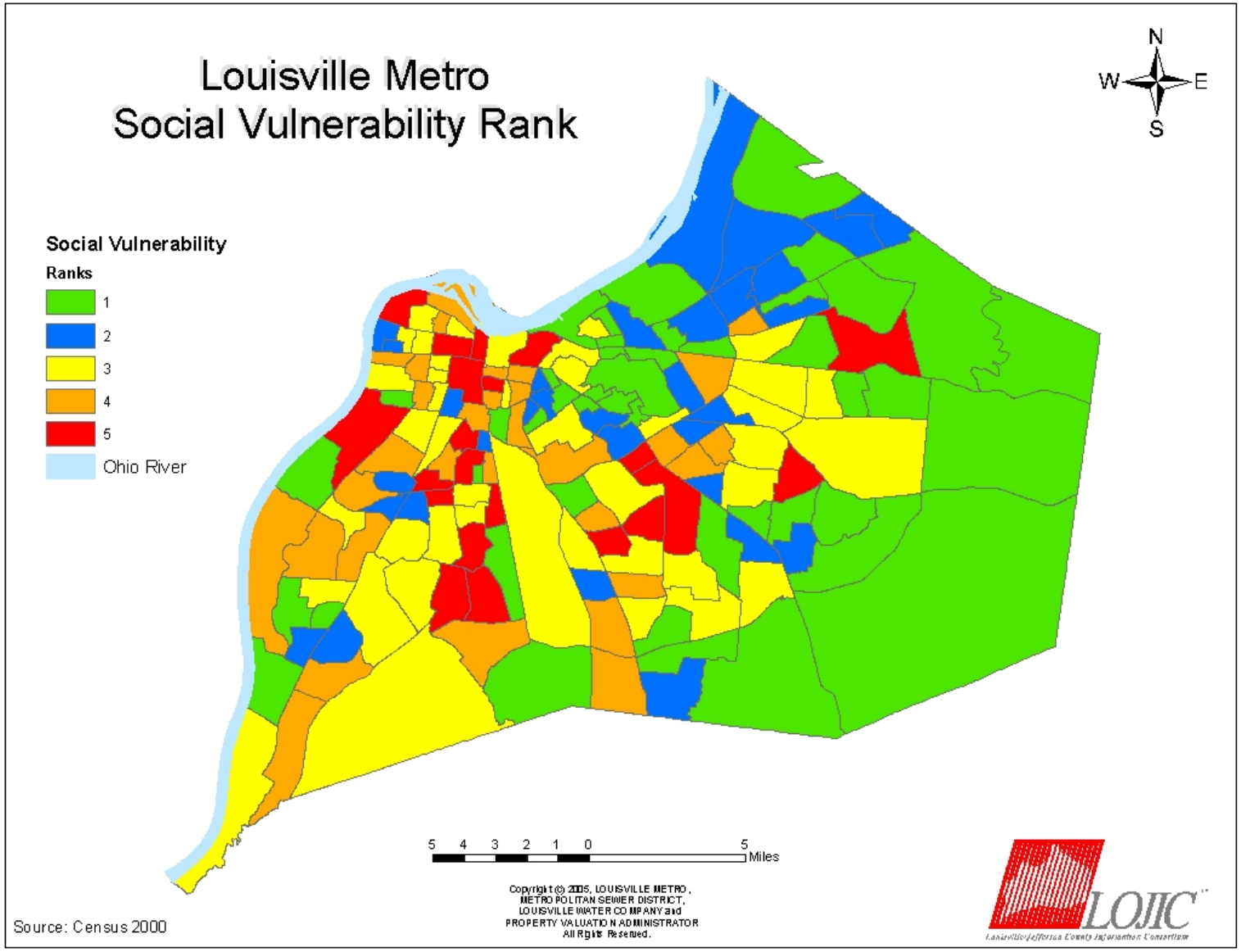
The total number of utility facilities is the sum of communication, potable water (water storage tanks and water pumps), waste water (waste water treatment and waste water pump stations), electric power, and natural gas facilities, for each census tract.

The total number of utility facilities, by census tract, was ranked 1-5 (1=low, 5=high), using the Natural Breaks (Jenks) method producing a facility rank.

Next, the total mileage of gas, water, and sewer lines were totaled for each census tract and ranked as above (See Utility Facility Table in Appendix 13) producing a line rank.

Finally, the facility rank and the line rank were totaled producing a utility score. This score was ranked as above for each census tract producing the final utility rank shown in the Utility Facility Rank Map and also used to calculate the Exposure Score.

Social Vulnerability Rank Map



Natural hazards do not discriminate among populations, but the impacts in terms of loss and the ability to recover vary greatly among socio-economical populations. Special consideration areas are those locations where individual resources are minimal and personal resources for dealing with hazards can be extremely limited. These census tracts may be more dependent on emergency and public resources after a disaster and thus could be good investment areas for hazard mitigation activities.

The process to measure Louisville Metro's social vulnerability at the census tract level was conducted using the Census 2000 Summary File 1 (SF 1) 100-Percent Data and Summary File 3 (SF 3) Detailed Tables. These tables were used to analyze each census tract based on nine different variables of social vulnerability.

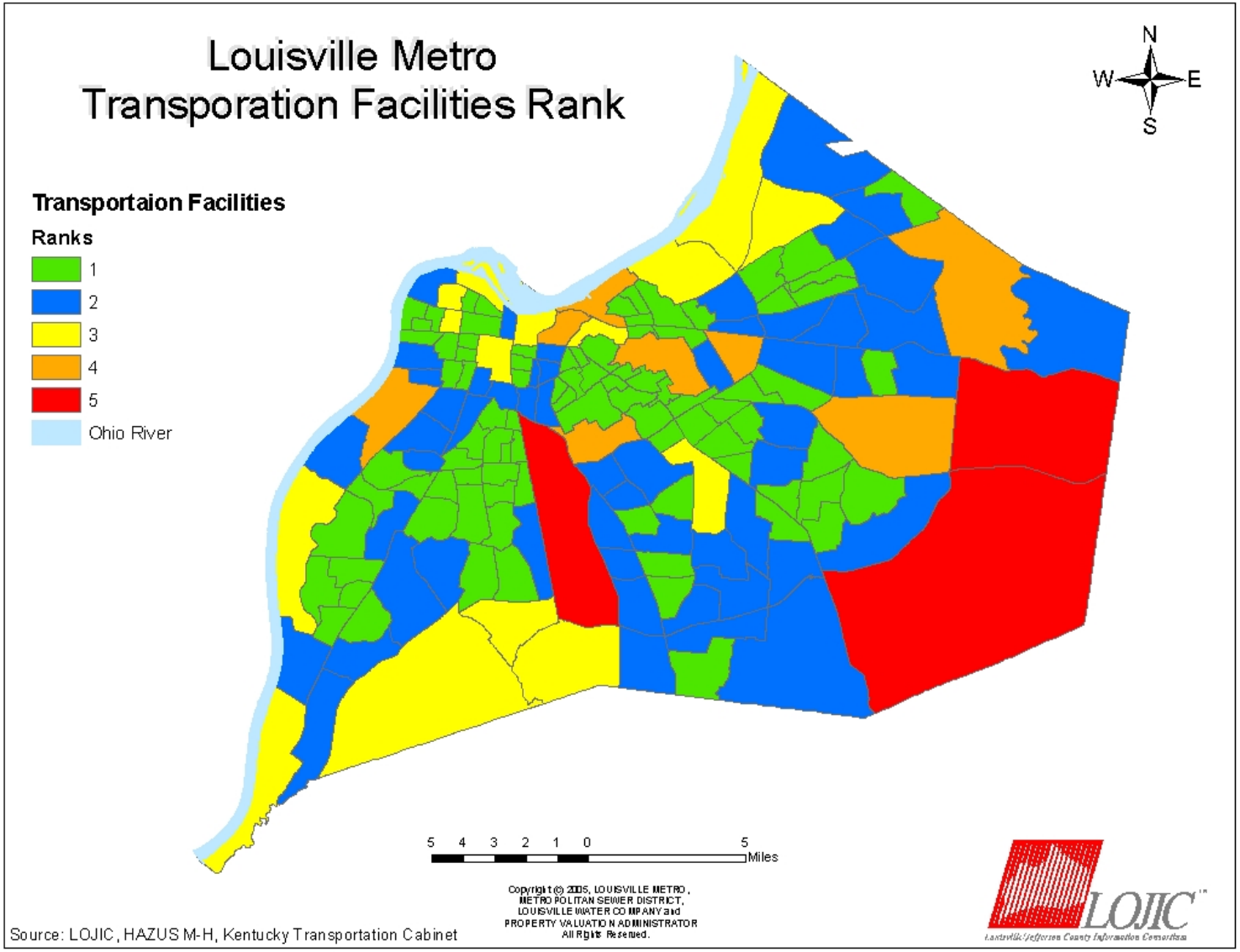
The following variables were chosen:

- Population living in poverty as defined by the Census Bureau
- Total number of families with a female head of household, no husband
- Total number of renters
- Population that receives disability assistance
- Population that is considered linguistically isolated
- Population that does not own a vehicle
- Population that is over the age of 65
- Households that receive public assistance
- Total number of manufactured homes.

The total number for each variable is graded on a scale of 1-5. The Natural Breaks (Jenks) method within ArcGIS was used to establish the grading, with 1 being the lowest and 5 being the highest.

Once each variable was graded, the grades were summed by census tract to achieve an overall Social Vulnerability Score and that score was ranked, using the previously described method, to produce a Social Vulnerability Rank for each census tract.

Transportation Facility Rank Map



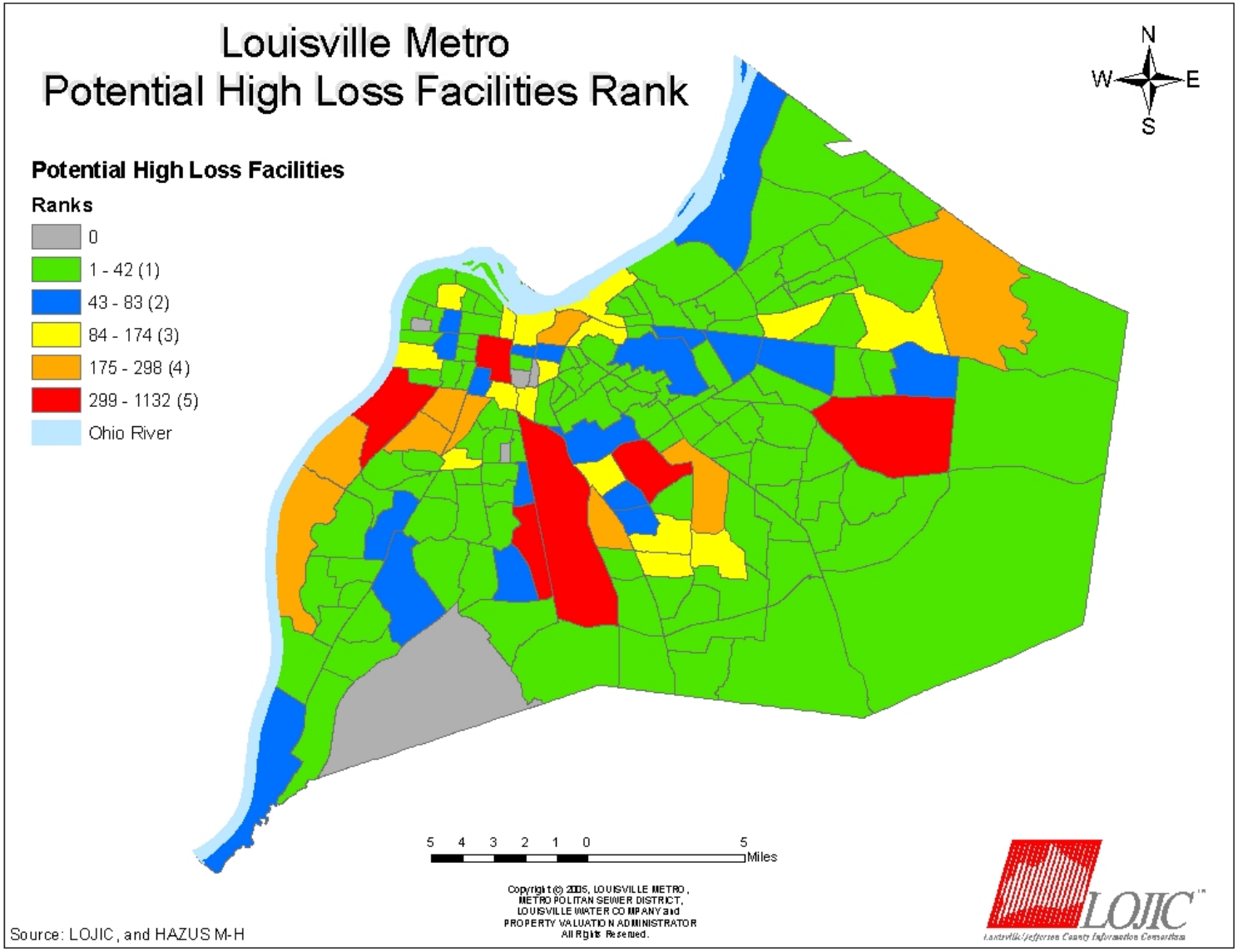
Transportation Rank is a census tract total of several different transportation facilities, including: airports, railroad stations, bridges and tunnels, bus stations, and ports. Once totaled, these facilities were ranked 1-5 (1=low, 5=high), using the Natural Breaks (Jenks) method provided in ArcGIS producing a facilities rank.

Second, railroad and road mileage, for each census tract, was totaled and ranked 1-5 producing a road and railroad rank.

Third, the facilities rank was added to the road and railroad rank producing a transportation facility score.

Finally, this score was ranked 1-5 to produce an overall Transportation Rank by census tract. The Transportation Rank is used to represent transportation vulnerability in the Exposure Score. Transportation facility information was obtained from HAZUS-MH, LOJIC, and the Kentucky Transportation Cabinet.

Potential High Loss Rank Map



Potential high loss facilities include the total amount of hazardous material and military locations in each census tract. These were obtained from HAZUS-MH and LOJIC.

Totals were ranked 1-5 (1=low, 5=high), using the Natural Breaks (Jenks) method provided in ArcGIS, producing a Potential High Loss Rank.